David Herring - C149

MCST All Hands Meeting Minutes 2DEC93

Time: Every Thursday, 1-2:45 p.m., in 22/G95

ATTENDEES:

Name	Phone	Organization
Anuta, Paul	X69412	RDC
Ardanuy, Phil	982-3714	RDC
Baden, Joan ***(Recorder)***	X61378	RDC
Barker, John	x69498	RDC
Braun, Charles	982-3754	RDC
Bryant, Tom	982-3769	RDC
Burelbach, Jon	X66166	RDC
Goff, Tom	982-3704	RDC
Harnden, Joann ***(Chair)***	x64133	GSFC
Hoyt, Doug	982-3732	RDC
Knight, Edward	X62382	RDC
Knowles, Dan	X61378	RDC
Kvaran, Geir	X62382	RDC
McKay, Al	X66739	GSFC
Maxwell, Marvin	595-5500	SWALES&Assoc.
Montgomery, Harry	x68117	GSFC

MINUTES:

Periodically on Fridays (at 12 p.m.) there are brown-bag seminars given by MCST Technical personnel in building 22, G95. If you would like to give a talk yourself, please contact Tom Bryant (982-3769). **The next Brown Bag Seminar will be given on December 10th by Stephen Ungar on Virtual Reality.**

Tom Bryant gave a presentation on Monitoring the MODIS Science Data (MMS) (Enclosure #1).

Summary of Presentation:

Bryant stated the following with regard to MMS:
- Project data online and provide hardcopy as one would expect.
- Provide near real-time processing (still to be determined as is the definition of "statistically significant").
- Currently, sizing is very conservative.
- Hardware concept will be very computer intensive, utilizing a network of UNIX stations and some processing will be done on dedicated hardware (Fast Fourier Transforms and histogram acquisition).
- DAAC gives us our documented telemetry and image data.
- Currently looking at C++ for software implementation
- Will attempt to correlate data spikes with known events, for example, Lunar View in spaceport; alias, Event Driven Processing.
- Will provide User Request Processing.

•Will monitor Health of all MODIS channels.
•Will alert operators to anomalies.
•Will operate in autonomous mode during normal operations.
•Will operate in a secure environment.

Response to MMS presentation:
Joann Harnden asked Harry Montgomery if the MMS would archive results so that they could see them historically.

Harry Montgomery said this aspect would be considered in MMS development efforts.

John Barker said that DADS may do this and should be reviewed as a potential interface.

John Barker stated that gain/offset should be listed as a subset of radiometric responsibility with regard to monitoring all MODIS channels, and there was general agreement.

With regards to data transmission:
Harry Montgomery asked if data is processed as it is available.
Barker responded that data is sent to a file. Some ability to catch up and review data by seeing it over and over.

Marv Maxwell commented that the issue to address is why have MMS at all. Is it necessary? Question to ask is what are we doing that normal calibration algorithm wont do?

Joann Harnden verified the necessity of MMS stating that MMS will perform cross-correlation and histogram analysis on the broad detector, and the normal algorithm wont do this.

Al McKay stated that he is working on Cal Plan inputs, and mentioned that if there are existing actions items that anyone knows about, tell Joan Baden or himself so that they can "get into the pipeline" so to speak.

Marv Maxwell asked if SBRC plans to change the light bulb before Thermal Vac and Barker responded that that would be a good suggestion, and Ed Knight agreed as well.

Knight addressed two things:
1)Spectral Thermal Optical Analysis (STOP)
2)Beginning and end of life issues with SBRC, examining decay.

Knight went on to say that STOP analysis was performed by Cherie Congedo and others on the engineering team. They looked at the beginning and end-of-life cases and the use of OBCs (On-board Calibrators). The results indicate that most pointing/coregistration errors will occur during the initial cooldown and the initial 1g release. The instrument appears stable after that.

Paul Anuta expressed concern with the diffuser plate exposed to Earth's scene radiation.

Knight stated that they can open/close door of Solar Diffuser when it is not in use.

Phil Ardanuy brought up the fact that Earth light will still come up through the scan cavity.

Stephen Ungar said that he is meeting with PRA to revisit their software tomorrow. DOD software project spends billions trying to produce synthetic scenes; concerned with thermal aspect. We may be able to incorporate a scene synthesis system into MODIS scene simulations.

Joan Baden asked that if someone completes an action item, then email her with the number of the action item, and the results of completion, including whether or not there should be a followup action item.

Barker stated that he is reviewing spectral filter data with Ed Knight because they may not have spec'd one of the bands correctly.

Jon Burelbach expressed concern about covering the range of spectra.
He said the lowest band is .412μm, and we need to get down to .38μm to cover the range and above 1.299μm..

Ed Knight said if we get above .3μm, we got all of it.

John Barker stated that Paul Anuta had contacts for Burelbach to achieve desired range.

<u>ACTION ITEMS:</u>
#28 Paul Anuta to give Jon Burelbach contacts for achieving spectra under .4μm or over 1.29μm (Jack Salisbury as one potential contact).

Enclosure: #1
Talk By: Tom Bryant/RDC/982-3769
Title: Monitoring the MODIS Science Data (MMS)
Date Given: December 2, 1993
Where: All-Hands Meeting,1:00 p.m.
NASA/GSFC/22/G95

To receive a hardcopy of the enclosures, email Joan (baden@highwire.gsfc.nasa.gov) and request by Enclosure #(s) and Date of presentation.

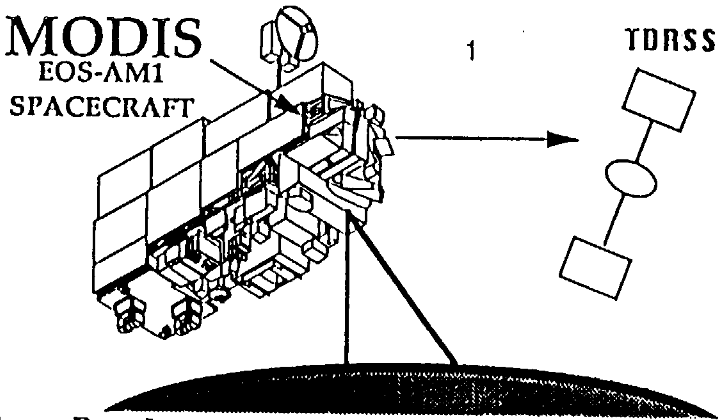
Monitoring The MODIS Science Data

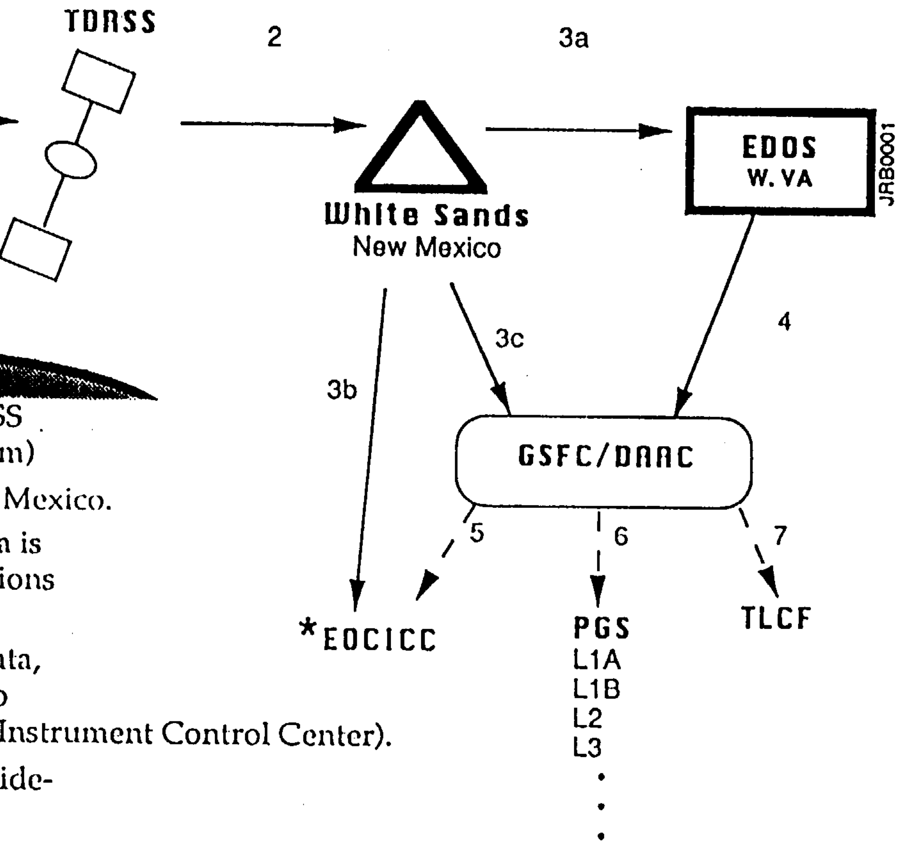
29 October 1993

Agenda

• Introduction	Harry Montgomery
• Overview of Monitoring Operations	Marvin Maxwell
• Implementing the System	Tom Bryant
• Current Status and Future Plans	Harry Montgomery

MODIS Satellite Data Flow Transfer Process





1- Raw Instrument Data sent to TDRSS (Track & Data Relay Satellite System)

2- Data relayed to White Sands, New Mexico.

3a- 2-3 hour potential delay before data is sent to EDOS (EOS Data & Operations System), West VA.

3b- Telemetry data (i.e., engineering data, termed Housekeeping Data) sent to EOCICC (EOS Operations Center/Instrument Control Center).

3c- Quicklook (5-10% of Total Data) Wide-Band; De-packetized.

4- EDOS has up to 21 hours from delivery of last byte of information to create time-ordered, packetized Level 0 data.

5- All L-0, Quicklook, or may want L-1A, etc. as they become available.

6- L-0 data received from GSFC/DAAC is converted to L-1A, etc.

7- Data relayed to TLCF (Team Leader Computing Facility).

NOTE:: Duplication of data because 2 solid state recorders on boardso some duplication when they switch from one to another.

*MCST has signed up to monitor science data to verify Health & Safety of data.

Rationale

- The product of MODIS is its science data.
- A system which monitors, in near real time, the status of the MODIS science data is needed to validate the instrument's performance.
- House keeping telemetry only gives indirect knowledge of the status of the science data.
- This information must be available to the operators ASAP, allowing the real time operational decisions to be made quickly.
- Overall program risk is reduced because the MCST has:
  - Provided the project with the MODIS calibration algorithms.
  - Knowledge of the scientific requirements.
  - Maintains a working interface with the science community.
  - Experience in developing complex software systems.

The MODIS Monitoring System (MMS)

- Operates in autonomous mode during normal operations.
- Monitors health and safety of all MODIS channels.
- Operates in near real time.
- Alerts operators to anomalies.
- Operates in a secure environment.

Autonomous Mode

- Requires no operator intervention during normal operations.
- Start-up is done automatically at machine start-up.
- A continuously updated graphical display of MODIS channel performance is output to the graphics workstation.
- Users can request MODIS channel status at any time.
- Hardcopy and electronic output can be tabular, graphical, or images.

MMS Monitors Health of All MODIS Channels

- For All 470 Channels Monitor:
  - Gain
  - Offset
  - Radiometric responsivity
  - Signal to noise
- Attempt to Identify Causes of Anomalies in The Data:
  - MODIS based
    - Focal plane temperatures
  - EOS platform based
    - Activity of other instruments
    - Attitude control problems
  - External phenomena
    - South Atlantic anomaly
    - Ground based radar
    - Solar flares

Operator Alerts

- Notify operators of anomalies when they occur.
- Both visual and aural cues will be used for operator notification.
- Anomaly reports will include:
  - Type
  - Severity
  - Suggested correction (if applicable)
  - Who to notify (if applicable)
- A log of all anomalies will be kept on line.
- Operations personnel will help design the user interface.
- MMS will support anomaly investigations:
  - Limited trending capability
  - Graphical tools

Near Real Time Operation

- Data will be processed as soon as it is available.
- Priority will be given to rapid examination of the data, as opposed to in depth analysis.
- Results from the MMS will be available within 100 minutes of the receipt of the data.
- The system will be sized such that it can examine a statistically significant portion of the MODIS data at the MODIS data rate.
  - Currently sized to process all of the data using 1 of 4 parallel processors on the Silicon Graphics workstation.

MMS Implementation Concept: Hardware

- Network of UNIX workstations
- Some processing will be done on dedicated hardware
  - e.g., Fast Fourier transforms and histogram acquisition
- User interface will be implemented on a graphics workstation
  - PV Wave or IDL or similar scientific graphical interface
- Decommutated telemetry and image data will be delivered by the DAAC

MMS Implementation Concept: Software

- Software design will utilize object oriented tools in a structured CASE environment.
  - Allows for reuse of code.
  - Currently planning to use C++.
  - EOC coding standards will be used to the maximum extent possible.
- Test plans and documentation will be developed in parallel with the rest of the system.
- Current sizing estimates indicate that the system can be built using high end workstations.

MMS Data Analysis

- Histogram capture and comparison within a spectral band.
  - Identifies changes in Responsivity and offset.
- Statistics from black body and space look are used to characterize S/N.
- FFTs from night look, black body, and space look data are used to identify coherent noise.
- Data from the MODIS calibration algorithms will be used to convert raw instrument counts to scientific units.
  - This conversion data will incorporate the current information about the MODIS calibrators.
- Data will be scanned for events which indicate that an event driven process should be run.
  - Attempt to correlate data spikes with known events.
  - Anomalies will be sanity checked where possible.

Current Project Status

- Accomplishments To Date
  - Baseline MMS requirements established
  - Draft phase A document complete
  - Preliminary histogram feasibility study complete
  - Top level system design and sizing estimate complete
  - Silicon Graphics 440 computer has been installed

Schedule

- **Delivery 1: January 1995**
  - Design
  - Develop requirements
  - Develop individual modules and test them
  - Integrate modules into system and test
  - End to end test
  - Delivery in time for SBRC MODIS bench tests
  - MODIS engineering model data flow starts in August 1994
  - Data from protoflight model scheduled to start in June 1995
- **Delivery 2: June 1996**
  - Revise requirements
  - Revise individual modules and test them
  - Integrate revised modules into system and end to end test
  - Delivery in time for Martin Marrietta Co. S/C tests which start in June 1996
- **Delivery 3: June 1998**
  - Revise requirements
  - Revise individual modules and test them
  - Integrate revised modules into system and end to end test
  - Delivery to support June 1998 launch for initial on orbit evaluation

MMS Resource Requirements

- One high end workstation and associated peripherals purchased every 3 years
- Hardware for specialized tasks
  - FFT generation
  - Histogram capture
- Network interface
  - MMS to DAAC
  - MMS to calibration system
- Personnel
  - 1 Instrument scientist (part time)
  - 1 LAN / TCP-IP expert (part time)
  - 1 Systems analyst
  - 1 Programmers
  - 1 Technical writer

Summary

- The MMS is needed to assess the MODIS data quality
- The MMS is feasible using current technology
- Successful MMS development requires fulfillment of the stated resource requirements and customer participation in the design and testing stages

Glossary

ASAP	As soon as possible
C++	An object oriented version of the C language
CASE	Computer Aided Software Engineering
DAAC	Distributed Active Archive Center
FFT	Fast Fourier Transform
IDL	A commercial scientific analysis and graphics package for workstations
LAN	Local Area Network
MODIS	Moderate resolution Imaging Spectrometer
MMS	MODIS Monitoring System
PV Wave	A commercial scientific analysis and graphics package for workstations
SBRC	Santa Barbara Research Center (Hughes)
S/C	Spacecraft
SD	Solar Diffuser
S/N	Signal to Noise
TCP/IP	Transmission Control Protocol / Internet Protocol

Software Constraints

A rough estimate of development time for software is given by:

$$\text{Effort} = \frac{L^3}{C^3 \quad T^4}$$

where

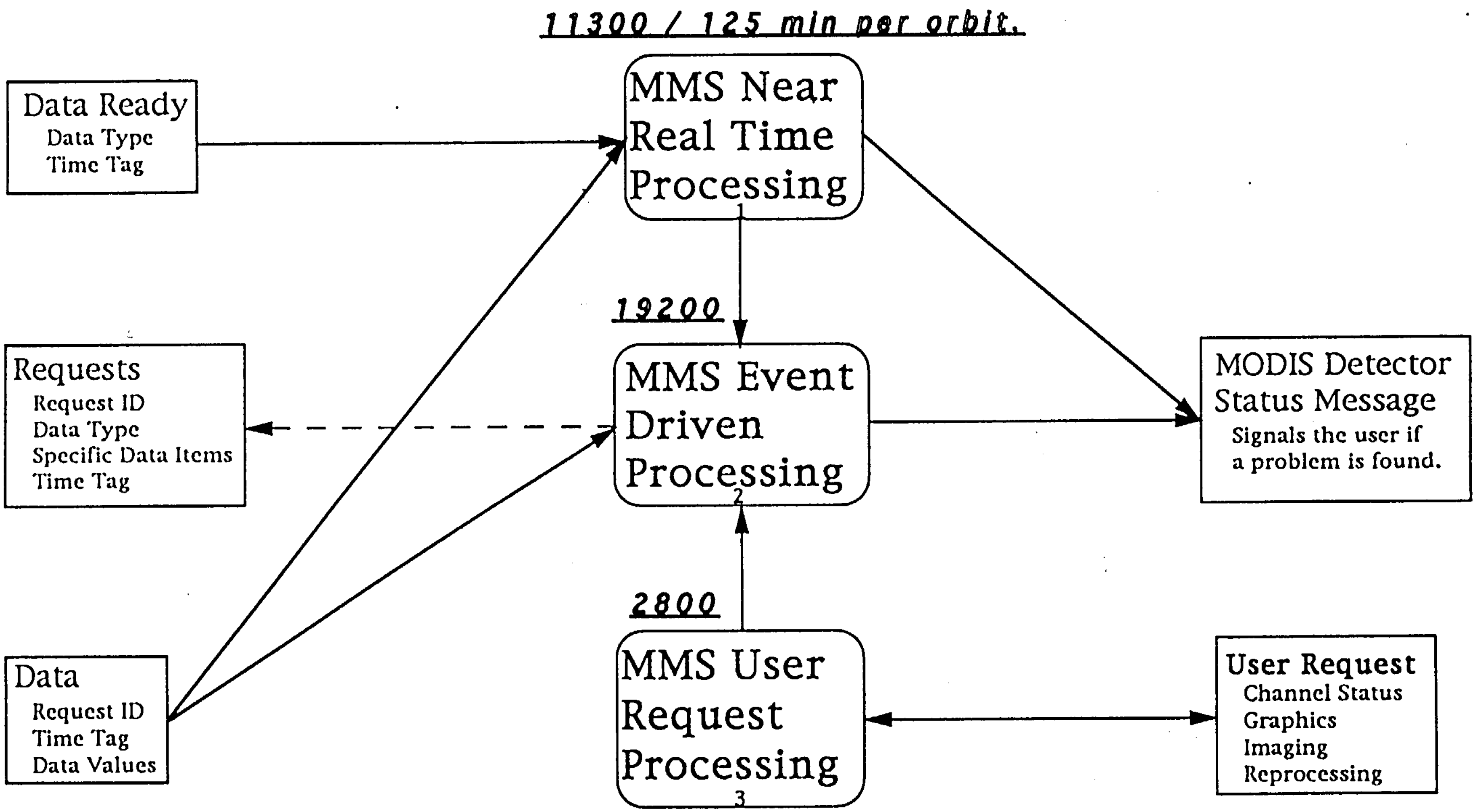
Effort is the number of staff years required
L is the number of lines of code in thousands
C is the efficiency of the development environment
T is the time allotted for the project, in years.

If a project requires 35,000 lines of code, and has 3 full time people working on it, it will require around 2 years in a fairly productive environment (C= 10^4)

If that same project must be done in a year, it will require about 40 people.

Time is of the essence in software development.

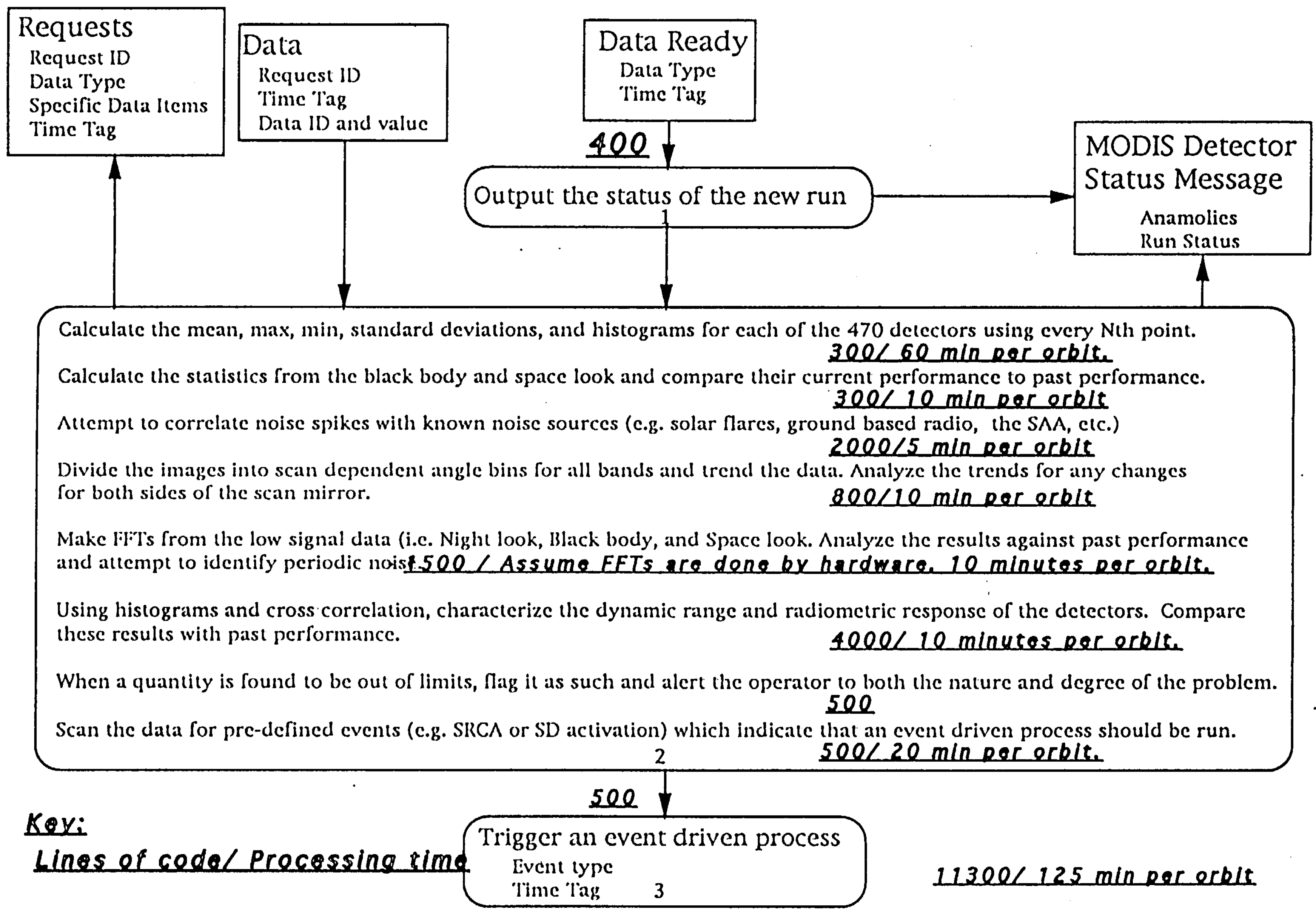
MMS System Layer 1: MMS overview



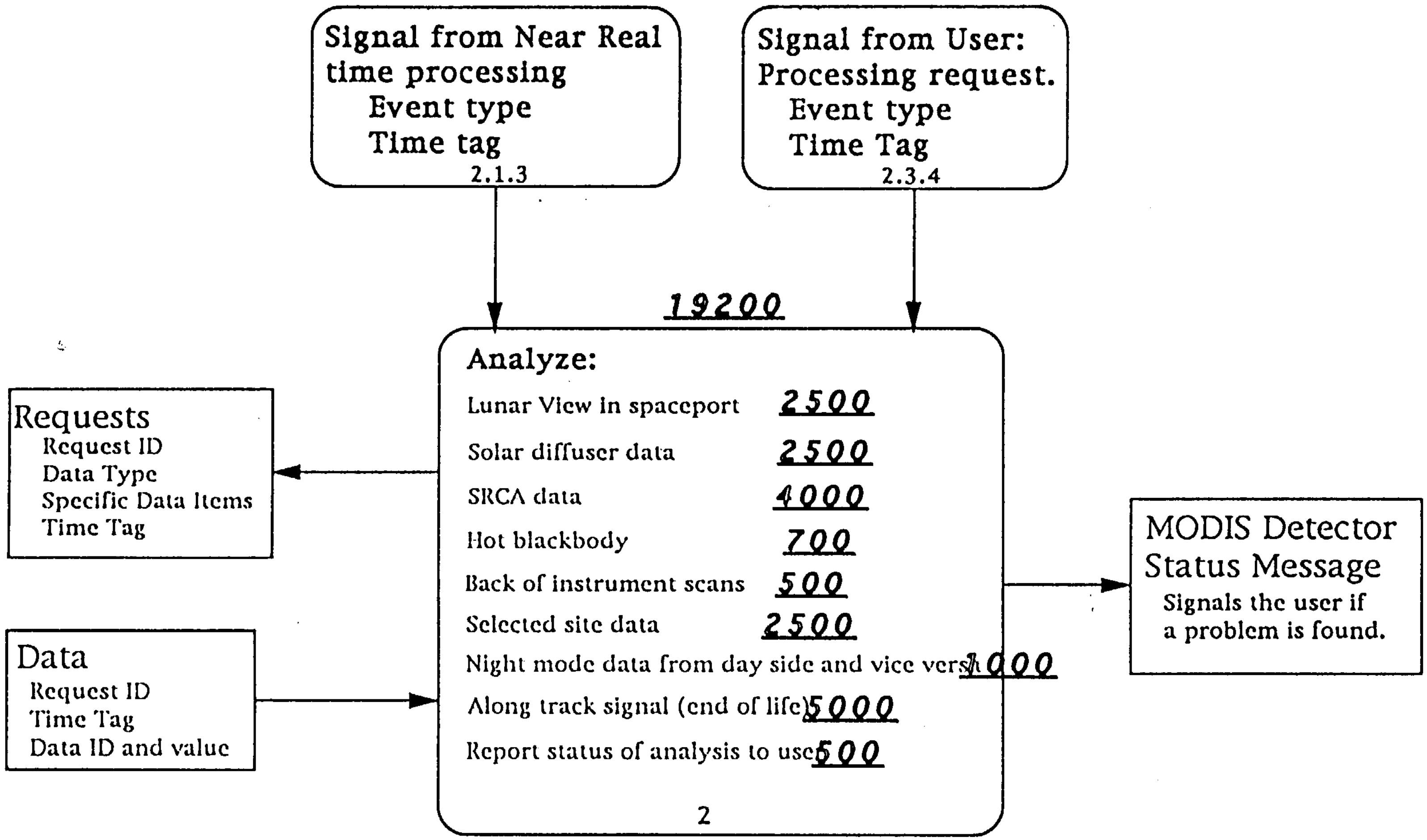
Key:

Lines of code / Estimate of processing time.

MMS Layer 2.1: Near Real Time Processing

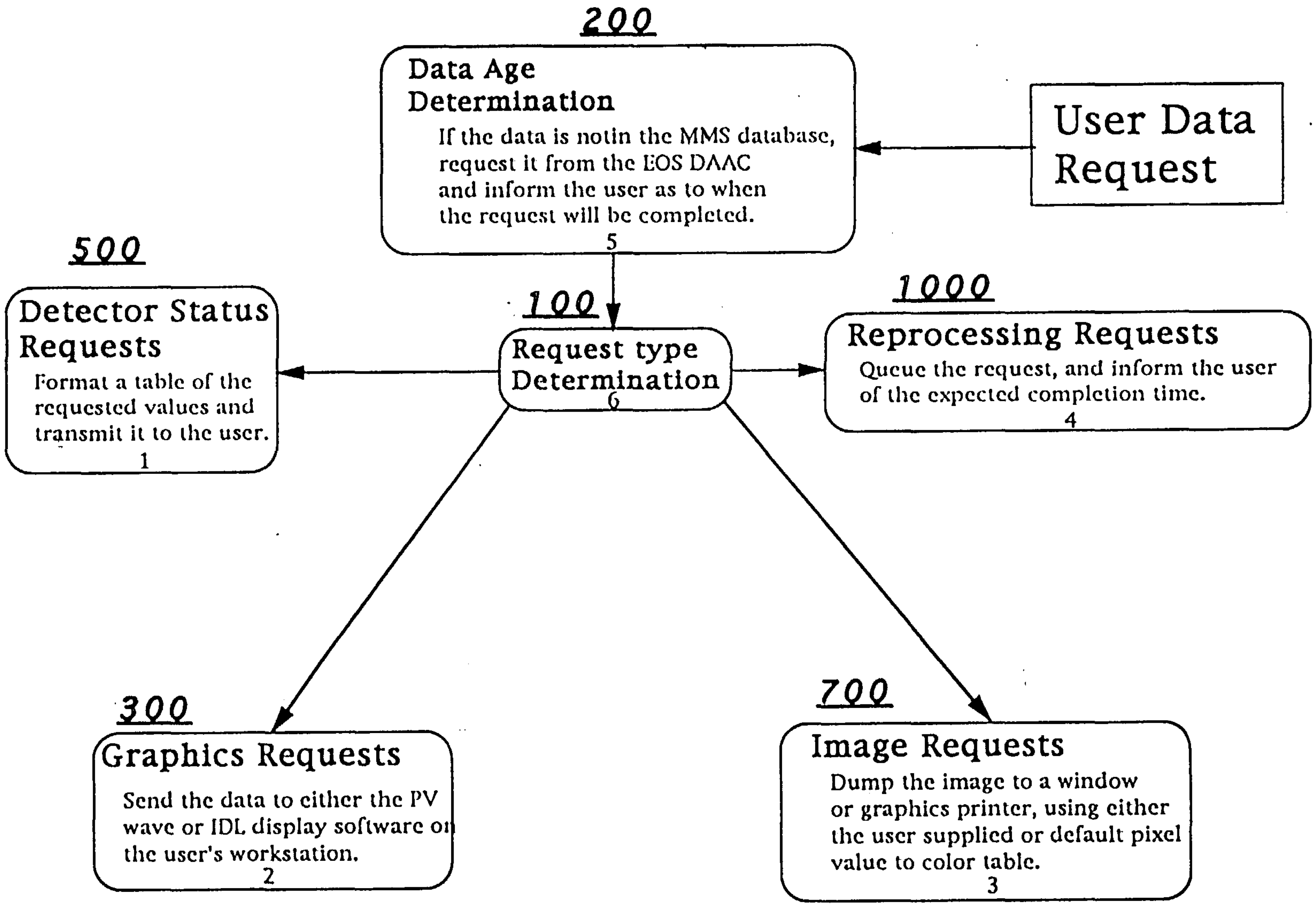


MMS Layer 2.2: Event Driven Processing



CPU utilization by these routines will depend on the amount of data scanned in each run and the frequency of runs.

MMS Layer 2.3: User Request Processing



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